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MENTAL MECHANISMS

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PART II

Movement, as Balzac would have said, or dynamism, as we say nowadays, that is the essence of life. As suggested before, it occurs as a result of growth and the general adaptive processes. Dynamism is initiated by a 'stress' or challenge, to which the organism responds. The challenge has certain describable characteristics:

1. Source and direction: that is from the environment of nature and man or from within the mind and body, directed mainly to the soma or psyche.
2. Strength: varying from acutely inimical threats calling forth maximum alertness in anticipation, or damage necessitating repair, to the milder challenges which keep us awake and about our daily tasks, with minimal effort—habitual behaviour.
3. Duration: varying from instantaneous causing shock (such as the receiving of bad news) to prolonged causing wear and tear (such as the earning of one's bread and butter).
4. Quality and kind: such as the compulsions of growth and decay within the organism and, more mysteriously, the inner mental forces clashing in conflicts and hardly less inimical than acute infections. This latter kind of challenge is portrayed in the classics by Fate, with its inexorable march of events—truly a reflection of man's inner struggle and the essence of tragedy. To give an instance, one may think of the everlasting opposition of Good and Evil in Faust.

And so each dynamic chain of events is analysable first in terms of the challenge that is to be met. The response to the challenge is to be described next. In general, it may be called upon to prevent stress, to reverse its effects, to repair and so to defend the total organism and preserve its vital links with the environment (family, occupational, social and national milieu, etc.); but it may also be called upon by a complexity of inner challenge, not to defend but to create as glorious a work as the Sistine Chapel in Florence, the Taj Mahal in Agra or the Mona Lisa in Paris.

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The general biological responses to challenge are classifiable in terms of their *polar* direction, namely:

(a) Fight—the positive response,
(b) Flight—the negative response,
(c) Freeze—the ambivalent response.

Each of these may be appropriate and effective and thus healthy, or inappropriate and eventually ineffective. In the latter case, the wrong response may be evoked (say a boy's flight from a smaller and younger bully), or the right response originally may be excessive or prolonged or unnecessarily repeated in the face of feeble or actually non-existent (outwardly unreal) danger. In choosing the right response, the challenge, of course, must always be taken into consideration. Just as bacteria evoke positive chemiotaxis and viruses negative chemiotaxes, so a man, threatened by another or a situation to which he is equal, meets it and overcomes it, whereas, in an unequal situation, he discreetly avoids or circumscribes the danger by a strategic use of retreating defenses in the manner of the Russian armies in the Napoleonic wars. When the choice of reaction is faulty, as in pneumonia with leukopoenia or a man avoiding his responsibilities in business or home affairs, decided pathology sets in.

In timing the direction of response and in gauging the necessary quantity (or intensity) of reaction, pathology may also set in. Just as a brief exposure to a gas irritant may evoke an excessive response: pulmonary oedema, or a prolonged one: bronchial asthma, so a psychologically noxious stimulus may cause an excessive fear: panic, or a prolonged fear (even after the withdrawal of the original stress), such as in anxiety. With regard to the time factor as it relates to the nature of the challenge and reaction, just as the pathogenesis of shock or chronic illness is analysable in terms of predisposing, initiating and maintaining factors, so with psychologic collapse or chronic illness. However, it should profit us next to draw a distinction rather than a parallel. Whereas, in the physical realm, the objective, behavioural aspect of reactions, e.g., pyrexia, fibrillation, paralysis, is all important, in the mental realm it is the subjective (introspective) part of the reaction which is all important. Remembering this, the above-mentioned biologic (described in behavioural terms) responses contain psychic responses (within the mind) ranging from normal to grossly pathologic. Thus:

Fight is normal in an aggressive boy in the boxing ring, and in war, but abnormal in hostility, psychopathy, and manic states.

Flight is normal when "discretion is the better part of valour", but abnormal in hysteria, depression and schizoid withdrawal.

The freeze state is always abnormal because it is always clearly ineffective (except in reptiles and chameleons) and is represented by the obsessive states and catatonia.

We have pursued our subject in bold, broad, biological terms in order to take it to the finer and more particular description of specifically psychologic defensive responses to challenge—namely, 'the mental mechanisms', but before we do this, it seems desirable to discuss one more general aspect: Where does the energy come from to provide the organism with the means of defense? It is supplied by the instincts. There are many orders of instincts, but in ultimate analysis, the most fundamental dynamic forces are the microcosmic reflection of

those vaster forces eternally moving the universe.

(a) Those making for life (anabolic—collectively symbolised by EROS), and it is the resultant energy from this that is designated by the term LIBIDO, and

(b) Those making for death (catabolic—collectively symbolised by THANATOS), and the resultant energy from this is spoken of as MORTIDO. Mercifully, this is a weaker force at any particular time during the life of a person (or a group, a nation, or a planet) though, in the long run, it, too, achieves its purpose: to make room for more life and keep the thing moving. However, as a motivating force within man, we may demote it to the order of a 'drive' opposing an instinct.

The total instinct making for life can, in turn, be subdivided into primary components:

1. The self-preserving instinct—supported by the aggressive drive,
2. The self-propagating instinct—supported by the sex drive,
3. The gregarious instinct—supported by the herd drive. Really this instinct overlaps and is part of the function of both aggression and sex, but, on the whole, it is supported by a weaker drive—a more negative summation of emotions: the fear and inadequacy of loneliness and the sense of incompleteness of the individual and even of a couple or family group.

In the fulfilment of these basic 'animal instincts', man is also guided fundamentally by the universal desire to fulfil pleasure (this he does not only in his short span of life on earth but also in his concept of life hereafter), and to avoid pain. The purely erotic desire, for instance, is teleologically related to the general sex drive seeking the propagation of the species but more immediately emotionally related to pleasure-seeking. EROS, then, stands for more than mere eroticism. The multitude of human drives, burning desires, passionate wishes and impulses stem from the warring faction of any or all of these biological 'primary' instincts. The instinctual drives of a person are related to other persons (objects) who are then invested by him with mental energy (cathexis). The primary investment is made in the self (narcissism) and specifically in areas of the body (autoerotic phase—See 1951 lectures). This is the period when the individual manipulates mostly himself for his needs (autoplastic phase). Subsequently, there is a distribution of mental energy to Mother (Oedipal situation), Father (Electra situation), siblings and general family group, and then to further groups—scholastic, occupational, recreational or athletic, social, etc. The energy is eventually distributed not only to people but also to ideas (humanism, search for knowledge and truth, religious faith) and, furthermore, to things (convertible cadillac, a feather in one's cap, and the finished recreation room). This constitutes the alloplastic phase.

One must add, however, that of all the concepts discussed, that of a 'death drive' is the most debatable and often denied even by some psychoanalysts. Yet my only justification for bringing it into this general framework of regarding mental phenomena is the same as the justification for inflicting any or all of these concepts on you—namely, they are *clinically* useful. For instance, in the schema of a polarity of instincts, where

dynamism occurs as a result of their eternal opposition, perversion occurs when MORTIDO attaches itself too firmly on libidinal drives and, more specifically, to erotic ones, thus resulting in sado-masochism; or when the death drive is as strong and weakly opposed as in agitated depression. Even on the somatic scene, when a carnivorous animal is prevented from devouring another or at least from obtaining animal protein for defense, growth and reproduction, the devouring need (the burning oral incorporating anabolic drive) turns inwardly (and changes polarity to a catabolic drive) and then the animal feeds on its own protein—this being the fundamental effect of starvation. So that, in order to live, an animal has to kill and eat or it will kill and eat itself. Similarly, on the psychic scene, aggression has to be continuously outwardly directed from the oral incorporating drive of the baby at the breast to the devouring intellect of the adult which feeds on another, hopefully weaker, intellect (though popularly this action is described in more phallic terms such as the sharpening of a keen mind on perhaps a blunter one), or to defeating or devouring others in business or in war. When prevented by an athletic or even a gigantic conscience (Super Ego) from doing this sufficiently to strike a balance and restore the tension accrued from the frustrated, dammed-up, aggressive drives, the person becomes perverted into sadism and, eventually, masochism which, in turn, will feed on and devour the personality, as in obsessive states and depression, or splinter and tear it apart, as in schizophrenia; with actual suicide as a mere bodily end, point to a psychological process began long ago.

Notwithstanding, you will observe that there is a difference in *goal* between the example given and the notion of a death wish: the animal devouring itself physically, or a man psychologically, does not do so out of choice but because he cannot feed on another. He does it not because he actively seeks death (incidentally, no animal other than man has ever been proven to commit suicide), but, on the contrary, in the hope of prolonging life until he can find a suitable victim and relief; whereas this theory proposes death as a goal in itself: though, even here, the eventual goal is to make room for more life and thus to observe the demands of Nature. Furthermore, the destructive drive tends to negate Fechner's theory or the stability principle (stating in general that the tension inherent in physical and mental processes always tends to remain at the same level, and that the nervous system reacts constantly to every increase in tension resulting from stimulation, in such a way that the former level is established): it also tends to deny Claude Bernard's and Cannon's homeostatic principle and the golden law of physics and chemistry. Yet does it? It certainly is difficult to conceive of mental energy being 'transformed' with death, and also to conceive of a portion of mental energy (MORTIDO) being dedicated not to restoration of the status quo but apparently to destruction. Yet there is possible reconciliation between these notions: the resultant force, of the two forces contending for life and death, works in the direction of homeostasis. In fact, the whole raison d'être of such elaborate mechanisms for homeostasis is the constant threat of destruction both from without and within. From a broad biological, and certainly from a cosmic point of view (whether this be the life and death of stars or the deposition and ero-

sion of soil or the constant upheavals of the oceans and their beds or the life cycle of plants and the animal kingdom), there is an eternal destruction and creation with the overall tendency to strike a balance, to conserve energy and to preserve and perpetuate some kind of order. At any rate, from a strictly clinical point of view, these notions are utilitarian in application. There are many forms of psychic dying: "Partir c'est mourir un peu"; popular language has it that 'something died within one'; the agitated depressive is bent on death; the phobic obsessed with the fear of dying is unconsciously striving for death; and even the fascinating syndrome of a person 'always late' and thus missing major opportunities for hope and creation, exemplifies a form of dying; certainly the schizophrenic, allowing fragmentation of his personality, the homosexual destroying his seed, and the alcoholic or accident prone, his body and mind, are all examples of a death drive. Here the idea of THANATOS is as generic as the idea of EROS was, for it may incorporate not only the drives to destruction of the flesh and mind, but also wishes for nihilism or the idea of suspended animation or the concept of prenatal life. Finally, it should be added that in all neuroses, there is a punitive (death-like) element which prefers unconsciously the neurotic state to another (normal) one, and this provides the final and most difficult stumbling-block to the success of psychotherapy. Unfortunately, space does not permit to illustrate clinically the useful application of these concepts, for this can only be done in a full course of lectures, bedside rounds and seminars. However, it is vital to have some concepts or else mental phenomena remain puzzling and chaotic and discourage the student.

Now, let us begin to consider, in more detail, the particular ego-defensive mental mechanisms we originally set out to describe. They may be arbitrarily divided into:

(A) Mechanisms mostly subserving growth and development and

(B) Mechanisms mostly subserving preservation of structure and function.

(A) First a few words on the process of psychological growth or maturation. It reaches its peak if and when the individual is able to make full use of his innate endowment. Usually, after maintaining such a relative peak or, at any rate, effective behaviour, there is a decline. The process of maturation has two goals. They are, in a sense, opposite in aims, namely: 1. Adequate *socialization*—the very basis of the definition or normality or, better, normativeness. 2. *Individuation*—when the person shows he not only can fit in his society but can apply his own individual imprint to it. It will be realized that these two goals, eventually diverging and conflicting (if one of them dominates a society), form the very basis of the present-day ideological struggle between communism and socialism on the one hand, and liberalism and democracy on the other.

Throughout development, the psyche (the ego) must maintain over-all control of all its various functions (somatic and psychological) which mature at differential rates, so as to present a uniform response ('a common front') both to the uneven demands of growth itself and also stress from elsewhere. This is comparable to the body's uneven needs during growth (e.g., in calories, proteins and sleep). But psychological demands made on a person are vast and contrasting. An example of uneven maturation, despite good ego control, is a successful execu-

tive, and captain of industry and men who may still be prone to the terrors of darkness, neglected since childhood, and thus the uneven demands of growth allowed him to remain immature in ego structure.

A person must not only continuously test outer reality with increasing awareness of how and why his world works the way it does, but must also concomitantly move towards a fuller self-realization where the demands of his animal self (ID) and his civilized self (Super-Ego) and of his idealized inner images of man and woman and, also, his primitive images and spectres (archetypes) must be met and dealt with. The cohesive power achieving this control is called *integration*. A great deal of the character of a person depends on its even growth which, in turn, depends on whether stimuli and stresses are judiciously balanced against the capacity to withstand them. Excessive stress, trauma or deprivation may break the cohesive forces during the period of growth and lead to:

(a) Retardation with consequent immaturity, as in all neuroses,
(b) Character fixation, as in all psychopathy and obsessive states,
(c) Regression, as in 'functional' psychoses,
(d) Deterioration and even disintegration, as in some 'organic' psychoses.

Vicarious stimulus or its entire lack through over-protection may lead to diffuse 'atrophy' whether the result be in the use of a limb, good manners, music appreciation or the use of memory and intelligence. The capacity of response to stress is as important here as it is in the relationship of stimulus to labile tissues: on the one hand, stimulus excites cytoplasm and mitosis causing growth and enlargement (as in the actively growing skin or muscle); on the other hand, labile tissues may be stimulated to grow in disorderly fashion as in neoplasm. Thus also with the immature delinquent whose lability delays maturation and whose eventual delinquency is the resultant of stress exceeding capacity to withstand and thus compares with tumor formation. Though both these analogues break certain laws of nature and result in pathology, they obey others and are not chaotic or anarchic, and so capable of study and potentially of cure. But, at present, 'cure' in both instances is doubtful and surgery (cutting off from the corpus of society) is the usual expedient.

It is curious that in both the somatic and psychologic study of man, maturation indices (like deterioration indices) are lacking in that there are no good measures allowing us to assess the normative or average and thus declare those who fall outside the hyperbole as abnormally delayed or fixated immatures. The hope is that the few indices which suggest themselves to us: ossification, dentition, weight, height, and generally physiognomic and anthropometric measurements 17 ketosteroids, capilliary looping, oximetry, the RBC and Hb in infancy, the iron store, EKG, heart rates in early years, calcification of tissues (like the pineal in later years), EEG, and secondary sexual characteristics, etc., may be combined with psychological and psycho-dynamic quantitative evaluations (see my diagram of libido organization in the former lectures, 1951) to give a psychosomatic index of maturation. With these thoughts in mind, we proceed to a listing of mental mechanism supporting the ego in its role of guardian of the growth and maturation of the mind.

THE AUTONOMIC NERVOUS SYSTEM

JOHN W. SCOTT, M.A., M.D.

About a century ago Claude Bernard introduced the term "milieu intérieur" or internal environment to describe the fluid that surrounds every living cell of a complex organism such as man. The ability of the body to maintain within narrow limits, the chemical composition and physical properties of this fluid permits man to live under a wide variety of climatic and dietary conditions. It is the function of the autonomic nervous system to prevent change in the milieu intérieur and keep on hand adequate stores of expendable substances. This activity Cannon has aptly called "homeostasis".

Lying at rest under basal conditions, as for determining the Basal Metabolic Rate, the homeostatic mechanisms are almost in abeyance, but any movement will bring about appropriate changes in the environmental temperature or variation in the composition of the air will bring about appropriate change through the activity of the autonomic nervous system. The simple act of getting up and walking across the room calls for a redistribution of the blood flow, increase of respiration, dissipation of the heat produced, and a restoration of the blood sugar burned. This is brought about by a series of general and local changes, which are controlled and integrated by the hypothalamic region of the diencephalon. The homeostatic activity is carried out with the sympathetic system predominating, while the protective and conservationist activities are dominated by the parasympathetic system. Most structures under the control of the autonomic system receive both sympathetic and parasympathetic innervation. The action of the two systems is antagonistic, or at least reciprocal.

In the embryo the cells of the autonomic system form a single gray column, known as the general visceral efferent column. It lies at the dorso-lateral edge of the basal lamina of the primitive neural tube. As the embryo develops it is broken into several segments. In the midbrain it appears as part of the Edinger-Westphal nucleus. In the medulla it is seen as the Salivatory Nuclei and the Dorsal Nucleus of the Vagus. In the thoracic and first lumbar segments, it is represented by the Intermediolateral column, which gives rise to the sympathetic outflow. The sacral outflow arises from a similar portion of the gray column in the second, third and fourth sacral segments. The cell bodies located in this column send their axones out in the ventral roots of the adjacent peripheral nerves.

Peripheral somatic nerves consist of two types of fibres, the afferent or sensory fibres, and the efferent, or motor fibres. The sensory fibres enter the cord by the dorsal roots. The cell bodies of these nerves are in the dorsal root ganglia or their homologues on the cranial nerves. Although the cell bodies are in the dorsal root ganglia, all the axones enter the cord before forming a synapse. There are several types of sensory fibres encountered

in a peripheral nerve: large, medium and small myelinated fibres, as well as non-myelinated fibres. As yet the exact function of all these various fibre types has not been determined. The motor fibres leave the cord in the ventral roots and on purely anatomical grounds can be divided into three main groups. First are the somatic motor fibres, which do not form a synapse in the peripheral path. Next, the sympathetic nerves can be recognized because of the position of their synapses in the sympathetic ganglionated chain. Finally the parasympathetic fibres are identified by the position of their synapses on or near the viscus supplied. The peripheral autonomic fibres differ from the somatic nerves in that they all form a synapse with another neurone in the periphery. Because of this synapse there are always two neurones in their peripheral pathway. For descriptive purposes these have been labelled the preganglionic and the postganglionic neurones.

In the thorac-lumbar outflow, which constitutes the sympathetic system, the synapses and the postganglionic cell bodies are gathered together in the ganglionated chains or in the paravertebral plexuses such as the Coeliac and Mesenterics. These are prominent structures which are easily available to surgical attack. In the cranio-sacral or parasympathetic outflow, the cell bodies are located at the periphery; usually on or in the viscus supplied. Thus there are few discreet ganglia that belong to the parasympathetic nerves. Hence the surgeons can do only a preganglionic parasympathectomy.

The somatic motor nerves supply striated skeletal muscle only. All other motor functions are the domain of the autonomic system. Consequently the autonomic system sends branches to all systems in all parts of the body. Although the sensory fibres can be separated anatomically and functionally, they travel with the motor fibres in both the somatic and the visceral nerves. Physiologically, there is no difference between the activity of somatic and visceral sensory nerves. It is the custom to consider the autonomic system as purely motor. However, in the autonomic, just as in the somatic, sensory impulses are essential for useful controlled function.

Most visceral structures are supplied by both sympathetic and parasympathetic nerves. The cranial portion of the parasympathetic system sends fibres to the intrinsic muscle of the eye, to the lachrymal and salivary glands, the respiratory system, the heart and the gastro-intestinal tract as far as the mid-colic region. The remainder of the colon and the pelvic viscera receive their parasympathetic supply from the sacral outflow.

The sympathetic outflow arises between the first thoracic to the second lumbar segments. From here fibres pass up and down the sympathetic chains to be distributed to the whole body. Thus damage to the sympathetic chain at the root of the neck interferes with the sympathetic supply of the eye, and produces Horner's syndrome. Embryologically the heart and lungs originate in the cervical region, consequently the sympathetic nerves that originate in segments T1 to T4 pass up the cervical chain before passing down to the heart. The abdominal viscera are supplied by the splanchnic nerves from the Thoracic segments between T5 and T12 while the pelvic viscera are supplied from the lumbar segments.

The transmission of an impulse across

a synapse or from a nerve to an effector organ is associated with the release of a minute quantity of a chemical substance. Two such substances are recognized, acetylcholine and an adrenaline-like substance. A nerve fibre that releases the latter is described as adrenergic, while one that releases acetylcholine is called cholinergic. In the autonomic system all preganglionic fibres are cholinergic. All postganglionic parasympathetic neurones are also cholinergic, but the postganglionic sympathetic fibres are adrenergic, with the exception of the fibres supplying the sweat glands and some blood vessels.

In the peripheral autonomic paths there are two points at which drugs commonly act. These are the synapse in the ganglion, and at the effector organ. As both the sympathetic and parasympathetic preganglionic fibres are cholinergic, cholinergic blocking agents that act at the ganglionic level inhibit both systems. Transmission at a ganglion can be blocked by preventing the release of acetyl-choline. This can be accomplished by a procaine injection or by lowering the level of the serum calcium. Blocking can also be achieved by preventing the acetyl-choline from reaching the post-ganglionic cell. Curare, *tetraethylammonium* salts and hexa-methonium are the principle drugs of this type. The third group are those which produce a long lasting depolarization of the post ganglionic cells. Because of the depolarization these drugs first cause a period of marked excitation followed by paralysis. Nicotine is the best known drug of this type; but large doses of acetylcholine, if protected from the cholinesterases by eserine also block by depolarization.

At the effector organs, two different conditions must be considered because there are both adrenergic and cholinergic endings. At cholinergic endings the drugs that block the ganglion level will also block the nerve ending. Atropine and the related alkaloids also prevent the stimuli from reaching the effector organs. The drugs that block the adrenergic endings fall into two main groups. The Dioxane compounds destroy the adrenaline, while ergot, priscoline and dibenamine block the effector organs by preventing the adrenaline reaching them.

Activity of the sympathetic system can be stimulated by adrenaline and ephedrine, while the parasympathetic system can be activated by acetylcholine, pilocarpine or carbichol. Eserine (physostigmine) acts by destroying the cholinesterase, permitting acetylcholine to accumulate.

The Autonomic system is represented in the cortex but its main integrating nuclei are in the hypothalamus. The anatomists recognize more than twenty nuclei in the hypothalamus, however, these form four groups from a physiological point of view. The anterior group consists of the nuclei that lie above and anterior to the optic chiasma. The lateral group occupies the lateral portion of the tuber cinerium. The middle group occupies the wall of the third ventricle between the optic chiasma and the mamillary bodies. The posterior group consists of the mamillary bodies and the nuclei above them. The anterior and middle groups are parasympathetic, while the posterior and lateral groups are sympathetic in function.

The hypothalamus has one of the richest blood supplies of any part of the brain, which itself has a large quota. The hypothalamus is supplied by four or five pairs of arteries arising from the Circle of Willis, its main branches and

tributaries. The supra-optic and paraventricular nuclei have a capillary bed about six times as dense as the cerebral cortex. Consequently these nuclei are rapidly influenced by slight changes in the composition or temperature of the blood.

The afferents to the hypothalamus provide intimate connections with almost all other regions of the brain. Thalamohypothalamic fibres provide a path from the cortex and from the great afferent sensory system. The olfactory system sends fibres directly by the medial forebrain bundle, in addition to fibres from the fornix. From the corpus striatum fibres pass from the globus pallidus to the ventral part of the medial group of hypothalamic nuclei, while the stria terminalis connects the amygdala to the supra-optic nucleus. Various other paths have been demonstrated physiologically, but as yet have not been delineated anatomically.

The principle efferent tract arises from the posterior and lateral groups and passes to the spinal cord. Efferents from the Anterior and Medial groups probably join the same bundle. From the supra-optic nucleus of the anterior group, fibres pass downwards through the infundibulum to the posterior pituitary. As yet the pathways from the hypothalamus to the preganglionic cells of the autonomic system have not been defined anatomically, but there is no doubt about these paths physiologically.

Although the hypothalamus is the largest integrating centre of the autonomic system, recent study has shown that there is extensive regulation of visceral function by the cortex. If the areas of autonomic motor functions are plotted on a cortical map, they are found to overlap the appropriate somatic areas. Thus the diameter of the pupil can be altered by stimulation of the area in the frontal lobe that controls eye movements, as well as from the visual integration area in the parietal lobe.

The anterior cingulate gyrus is closely connected to the hypothalamus through the anterior part of the thalamus. Stimulation of this area produces changes of the "fight or flight" type. The orbital surface of the frontal lobe contains centres for vasomotor, cardiac and respiratory control. Extripation of this area induces the violent autonomic "storms" that have been called "sham rage".

Temperature regulation has two separate aspects; the dissipation of excess heat produced by metabolic activity and the production and conservation of heat, to prevent hypothermia. Heat is produced in the body by the metabolic activity of the viscera and also by the action of muscles. It is dissipated by radiation and conduction from the surface and by evaporation of water from the skin and respiratory system. If the body temperature is to *remain* constant, production must equal loss. In a normal individual, minor adjustments of temperature are brought about by constriction or dilatation of the skin vessels, while major changes require sweating or shivering. Many animals that do not sweat, dissipate heat by panting.

Temperature regulation is a supraspinal function. A spinal man, neither sweats nor shivers below the segmental level of his lesion for the regulation of body temperature. Because of this, the body temperature of many paraplegics and all quadraplegics rises two or three degrees in hot summer weather, and blankets are needed to prevent hypothermia in cool weather.

Two regions of the hypothalamus are concerned with temperature regulation.

If that part of the anterior hypothalamus near the mid-line above and anterior to optic chiasma is warmed, vaso-dilatation of the skin vessels and sweating occur. If this region be destroyed, the individual's ability to dissipate heat is lost, and hyperthermia results. However, such an individual is able to prevent hypothermia by vasoconstriction and shivering. This is a function of the posterior hypothalamus, and in animals is accompanied by pilo-erection. Destruction of the posterior hypothalamus abolishes the ability to conserve heat, so that such an individual's temperature falls. Thus hypothermia is related to loss of sympathetic activity, due to damage of the posterior hypothalamus, while hyperthermia indicates damage to the anterior hypothalamus.

The decorticate animal has normal autonomic activity, with well regulated homeostatic control. The decerebrate animal on the other hand does not show these reactions. The acute decorticate animal has paroxysms of excessive sympathetic activity characterized by a rise in blood pressure, increased heart rate, dilatation of the pupils, and the hair standing on end. Because of the angered appearance of the animal these outbursts have been termed "sham rage". Bard found that these reactions are abolished if the posterior hypothalamus is destroyed. Stimulation of the posterior hypothalamus will induce similar widespread sympathetic activity.

Injury or stimulation of the hypothalamus will induce a rise in blood sugar; but the evidence indicates that the mechanism of this rise is a stimulation of the adrenal medulla via the sympathetic nerves. The mechanism of the lowered blood sugar following experimental lesions of the anterior hypothalamus is not known. However, such lesions cause a great increase in appetite, the excess food appearing as fat. Possibly the obesity of Froehlich's syndrome is due to the disturbed function of this area rather than to the pituitary itself.

The kidney is the ultimate effector organ for the regulation of the concentration of the blood. However, the kidney is not free to function independently, and a diuresis may be stopped equally well by: (a) Severe pain. (b) Stimulation of the orbital surface of the frontal lobe. (c) Stimulation of the spura optic nuclei of the hypothalamus. (d) Injection of pituitrin. (e) Emotional states, such as anger, rage, and fear.

Trueta has shown that severe pain opens the glomerular shunts of the kidney, thus stopping urine formation. This is a spinal reflex, for it continues after transection of the cord. From the orbital surface of the frontal lobe impulses pass back to the supra-optic nuclei which in turn send impulses down the hypophyseal tract, which liberate the antidiuretic hormone into the blood, which, after a few seconds delay, will reach the kidney and stop the diuresis. In as much as ablation of the orbital surface causes sham rage, it is possible that the emotions act through the same paths.

In his Croonian lecture Verney describes his experiments showing that a slight increase in the concentration of the blood in the distribution of the internal carotic artery would rapidly stop a diuresis by the liberation of the antidiuretic hormone. He demonstrated spherical vesicles 5 to 60 microns in diameter in the supra-optic nucleus. From his experiments it is probable that these are the receptors that are sensitive to the ionic concentration of the blood and they con-

trol the release of the anti-diuretic hormone. If so they are ideally situated in close contact with the nucleus known to control the release of the hormone and which has one of the richest vascular beds in the brain.

Thus the hypothalamus, by co-ordinating the various peripheral reflexes of the autonomic system, maintains the composition and temperature of the blood, which in turn ensures that the "milieu intérieur" will not change.

HOW ARE YOUR REFLEXES ?

A. GOLDBERG, 5T6

It is an appreciated fact that the application of many suitable stimuli elicits involuntary responses from the muscular, respiratory, and vascular systems, as well as from the digestive and glandular systems. If the intact central nervous system is an integral part of the activity, the response is called a reflex. The subject may become conscious of the stimulation, as when the eye blinks following touching of the cornea. However, many important reflexes, among them the continual blinking of the eyelids, occur in the absence of recognized excitation.

A typical reflex is the *stretch reflex*. If we pull on the tendon of an extensor muscle whose nerve supply is intact, the muscle contracts actively, the degree of response varying with the intensity of the pull (within physiological limits). Large afferent fibres from the receptor organs in the tendon enter the dorsal horn of grey matter in the spinal cord and continue on to the ventral horn, where they synapse with their respective efferent fibres. These efferent fibres then pass out to the effector organs in the muscle, thereby completing the reflex arcs.

Here are ten more reflexes. In how many cases can you name the adequate stimulus, the response obtained, and the reflex mechanism?

1. Direct light reflex.
2. Reflex secretion of saliva in response to acid in the mouth.
3. Coronary reflex.
4. Hering-Breuer reflex.
5. Carotid reflex in respiration.
6. Axone reflex.
7. Lovén reflex.
8. Aortic reflex in circulation.
9. Bainbridge reflex (or auricular reflex, or venous reflex).
10. Vagopressor reflex.

Answers to the reflexes listed on page 203.

BRONCHIAL ASTHMA

JOHN STALKER, 5T4

Definition

Bronchial asthma is a disease marked by recurrent attacks of paroxysmal dyspnea with wheezing, cough, and a sense of constriction in the chest due to spasmodic contraction of the bronchi.

Types and Etiology

Two forms of the disease are recognized.

1. Extrinsic Bronchial Asthma.
2. Intrinsic Bronchial Asthma.

1. The *extrinsic form* of asthma belongs to the atopic group of diseases which include hay fever, urticaria, eczema, serum sickness, contact dermatitis, hypersensitiveness to drugs and some instances of periarteritis nodosa. These conditions are expressions of a hypersensitiveness of body tissues to foreign substances.

Extrinsic asthma is an allergic manifestation and is clearly related to exposure to dust, pollens, animal danders, drugs, or foods.

Pure allergic asthma is most commonly seen in children and young adults. In these cases there is frequently a family history of allergy and a personal history of associated forms of allergy. In one group of 209 school children under 10 years of age who were suffering from asthma, it was found that 57 (27%) were suffering, or had suffered from eczema. In 102 cases (49%) a definite history of a near relative who suffered from an allergic condition was obtained. These latter figures suggest that allergy is transmitted by heredity according to Mendelian law and that a child may be born with an inherent capacity to become hypersensitive after repeated contact with an allergen.

2. *Intrinsic Asthma*: Two types are recognized.

(a) Infectious

This type is characterized by the presence of bronchial infection. This is the most common type of intrinsic asthma. It is often preceded by an infection of the upper respiratory tract before the development of asthma. The asthma may be an expression of bacterial allergy but there is no positive evidence for this assumption.

(b) The second type of Intrinsic Asthma is a severe form of asthma occurring in patients over the age of 40 years with usually no previous allergic background. The etiology is unknown but investigation into its cause has been directed to metabolic, endocrine, nervous and psychogenic disturbances.

The Psychological Factor in the Etiology of Asthma

The importance of the psychological factor in asthma is well recognized and the disease is rightly included among the psychosomatic disorders. It is generally agreed that though psychosomatic influences of themselves might not cause asthma, emotional stress frequently brings on attacks which stimulate asthma and also aggravates symptoms in allergic patients.

Pathology

The chief bronchial lesions are edema; smooth muscle spasm; and increased secretion from mucous glands. These

changes are confined mainly to the small bronchioles of the lungs. The lesions result in a decrease in the size of the bronchial lumen causing difficult and prolonged expiration.

On microscopical examination the following changes in the walls of the smaller air passages are seen:

I. the mucosa of the bronchioles is swollen and there is hyalinization of the basement membrane and hypertrophy of the bronchial musculature.

II. there is an increased amount of mucus in the bronchial lumen.

III. there is distension of alveolar sacs due to the great strain thrown on the pulmonary tissue during the expiratory spasm.

IV. the bronchiolar walls are infiltrated with chronic inflammatory cells, mainly eosinophils and in the presence of infection, neutrophils and bacteria.

V. there is a change in the columnar epithelium to goblet cells with loss of cilia.

In the intrinsic form of asthma, in addition to the above changes, the bronchi are seen to be occluded completely, by plugs of tough inspissated mucus. This material seems to differ in its consistency from the more fluid or softer mucus produced in typical early atopic asthma.

Clinical Manifestations

Asthmatic attacks frequently occur at night. The reason for this is not clear but it may be associated with the accumulation of bronchial secretion at this time. If the attack occurs during the night then, the patient awakens, short of breath. As the paroxysm develops he is unable to remain lying down but sits up with shoulders hunched and head bent forward and elbows held away from the side of the body. This position provides the patient with greater comfort in breathing. Dyspnea may be extreme, respirations are rapid and shallow and the expiratory phase is prolonged. Though the chief difficulty in breathing is considered to be in the expiratory phase, to a patient in a severe attack of asthma both phases of respiration are difficult.

The attack varies in duration, some lasting for hours and some, in cases of status asthmaticus lasting for days. During an asthmatic attack there is little cough or sputum. When the paroxysm has passed clear thick gelatinous mucus may be coughed up, an important factor in the bronchial obstruction.

ATOPIC ASTHMA. The history of a patient with atopic asthma will frequently reveal a positive family history of allergic disturbances and frequently a history in the patient's past of allergic manifestations, e.g. eczema in infancy or hay fever. The onset of asthma in such patients occurs usually before the age of 20 years.

NON-ATOPIC ASTHMA. In the non-atopic form, the patient usually presents no history of allergic disorders in his own history or that of his family.

This form of asthma presents 3 clinical manifestations.

1. The first of these is the most benign type and consists largely of persistent cough with production of clear mucoid sputum containing eosinophils, with but few pus cells and few bacteria in washed specimens. There are few if any true asthmatic paroxysms but distant wheezing and rhonchi usually can be heard on auscultation. On exertion the patient becomes aware of his wheezing. This condition is often referred to as asthmatic bronchitis. It may persist for years.

2. The second type described is the most serious. The patient who is usually

over 40 years of age with no allergic background begins to cough at night or in the early morning hours and soon develops the characteristics of the first type. Some months after the onset a true asthmatic paroxysm occurs. These attacks grow in frequency and severity until status asthmaticus, that is, intense intractable asthma, appears. Such paroxysms may continue for days, recur frequently and become more resistant to treatment. Such attacks may have marked effects on the patient. During prolonged attacks extreme dyspnea prevents the patient from sleeping, eating and drinking, the result being loss of weight, dehydration and even ketosis. There is frequently a low grade infection present in these cases. The extremely acute emphysema which develops from these severe attacks, leads to an advanced chronic type in a surprisingly short time, especially when the onset is later on in life. When a severe paroxysm supervenes on such lungs already permanently distended and with markedly reduced vital capacity, cyanosis may be great and air hunger intense.

3. The third type of non-atopic asthma which is recognized clinically is characterized by the presence of bronchial infection. This is the most common form. This type is usually suggested by a preceding history of an upper respiratory infection. The asthmatic attack usually begins during the height of the infection and subsides as the infection clears. This type is often seen in patients with a previous history of atopic asthma.

In any asthmatic attack, physical examination apart from the laboured breathing, sometimes fails to provide any additional knowledge to that gained in the history. Frequently, however, on auscultation wheezing rales and rhonchi may be heard as inspired air is forced past the obstruction in the smaller bronchi (which has developed) due to accumulation of exudate and congestion of the mucus membranes.

Laboratory Procedures and Diagnosis

At least some of the following laboratory procedures should be carried out in all cases of asthma.

1. NASAL SMEAR. According to some writers this is probably the most important laboratory test to be used in dealing with respiratory disease. The condition of the bronchial mucosa is reflected in the picture of the nasal mucosa. Therefore, if the nasal cavity presents an absolutely normal anatomy, one should be sceptical that he is dealing with a true bronchial asthma. The presence of many eosinophils in the nasal smear is definite evidence of an allergic response. In the infectious form of Intrinsic Asthma the smear shows neutrophils and bacterial organisms.

2. BLOOD DIFFERENTIAL COUNT. A rise of eosinophils to 5% or more in a differential count, indicates an allergic response. Allergy is the most frequent cause of eosinophilia.

3. SKIN TESTS

(a) *Scratch method.*

(b) *Intradermal method.*

Many observers feel that the skin test is still a useful procedure. In the scratch test, powdered prepared allergens are placed on a series of cuts made through the superficial skin layers. These are then dissolved in a drop of 0.1N NAOH. This is the safer of the two methods but the intradermal test is much more sensitive. However a severe constitutional reaction may occur in a highly sensitive patient no matter what type of testing is employed. Deaths have occurred even with the scratch method. The skin test then,

has certain limitations. Furthermore, only about 60% of patients with asthma give positive skin tests. The remainder are either atopic, without antibodies in cutaneous cells, or belong to the non-atopic group. On the other hand 25-30% of non-atopic individuals give positive tests to the standard lists of common allergens. Thus in these cases, only the skin contains antibodies to specific allergens and the other tissues remain free, so no reactions occur which can give rise to attacks of asthma or hay fever, gastro-intestinal disturbances, etc. In recent years skin testing has been greatly simplified for it has been found that in most cases of allergic asthma, severe enough to require treatment only a few allergens are responsible for the symptoms. These are the ones encountered continually such as house dust, milk, dander from household pets, cosmetics, and seasonal pollens.

4. HISTORY. The most useful diagnostic procedure in the study of asthma is the taking of a good history. This frequently enables the examiner to determine the offending allergen and it is useful for making a differential diagnosis of the condition. Thus a family history of allergy would tend to distinguish the wheezing in bronchial asthma from that of chronic bronchitis or cardiac asthma.

Other laboratory investigations may include:

5. ROENTGENOLOGICAL OR FLUOROSCOPIC EXAMINATION OF THE CHEST.

Observation of the chest between paroxysms is important in determining the position and excursion of the diaphragm. In the presence of early emphysema even before the vital capacity is reduced the diaphragm will be somewhat lowered by the distended lungs and its excursion that much restricted.

The following laboratory tests are particularly useful in the investigation of infectious (intrinsic) asthma:

(*a*) Sedimentation Rate.

(*b*) White Blood Count and differential Count.

(*c*) Bacteriological investigation of the sputums and antibiotic sensitivity tests.

(*d*) Skin testing with bacterial, fungus and viral extracts.

Findings which show depressed sedimentation rate and increased white blood count suggest a diagnosis of infectious asthma.

Course and Prognosis

1. ATOPIC ASTHMA. With early treatment both specific and symptomatic most of the complications of atopic asthma may be avoided and the prognosis is good. In this form of asthma, symptoms usually begin in the earlier years of life. Now it has been shown that the capacity to develop antibodies to allergens tends to diminish with succeeding decades so that if one can tide the patient over this early period the problem usually becomes simple as hypersensitivity diminishes.

2. NON-ATROPIC ASTHMA. The course and prognosis for the non-atopic form of asthma is entirely unpredictable.

The mortality figures for both types vary with reports from different authors. Some writers give figures of 0-1% in atopic bronchial asthma and 5-10% in non-atopic bronchial asthma. Other investigators give higher figures and warn that the rarity of death from asthma is overstressed in textbooks.

Complications of Asthma

In children who suffer from asthma, particularly in those not properly treated the following changes have been observed:

(a) SKELETAL: pigeon chest; kyphosis; scoliosis, and round shoulders

with contracted pectoral muscles.

(b) VISCERAL: emphysema; fibrosis of the lungs; bronchiectasis: and right heart strain.

These complications nearly always lead to restriction of occupational opportunity and even to diminished expectation of life. With chronic asthma in any age group emphysema is an inevitable complication, and it is this complication which permanently cripples the patient. When emphysema has become advanced cardiac complications may occur with pulmonary hypertension resulting in acute or chronic right heart failure. In such cases determination of the vital capacity and venous pressure at times when the patient's symptoms are quiescent aid in determining the prognosis for a particular case. Infection is another common complication of prolonged asthma. Others, less common include: atelectasis; spontaneous pneumothorax; mediastinal emphysema, with or without subcutaneous involvement; periarteritis nodosum; and traumatic injury to thoracic tissues, including the fracture of ribs. This last, is the result of extreme high pressures in the chest from severe coughing or wheezing.

CAUSES OF DEATH

The immediate causes of death in asthma are varied and include:

(a) secondary infection with bronchopneumonia.

(b) status asthmaticus, with complete physical depletion and severe breathlessness ending in respiratory failure, emphysema with great reduction of the vital capacity, anoxemia, and right heart failure.

(c) periarteritis nodosum.

It must also be remembered that the death rate from conditions not apparently related to asthma may be higher in asthmatics than in normal individuals.

TREATMENT

Treatment of bronchial asthma may be considered under the following headings:

(A) SPECIFIC TREATMENT

1. ATOPIC ASTHMA. This form of asthma is most easily dealt with and responds better to treatment than the nonatopic form.

Treatment of the Allergic Factor

Suspected atopens should be avoided as far as possible. A change of occupation or residence may sometimes be necessary to gain relief from the persistent allergic response to an offending atopen. It may be impossible for the patient to be separated from the atopen to which he is sensitive. In such cases hyposensitization should be attempted by injection of increasing quantities of one or several extracts of allergens to which the patient is sensitive. This treatment is only temporary usually, and in such cases boosting doses at monthly intervals will sometimes keep the patient in good health.

This form of treatment is not without danger, however, as a severe general reaction may follow with very sensitive patients. It may take the form of severe urticaria; angioneurotic edema; rhinorrhea; asthma, or vascular collapse. The addition of adrenaline hydrochloride to the desensitizing injections tends to diminish the chances of severe reactions.

2. ASTHMA WHICH ACCOMPANIES UPPER RESPIRATORY INFECTIONS OR INTRINSIC ASTHMA. This form of bronchial asthma is more resistant to therapy, for the eradication of infection from the bronchial passages is very difficult. The symptomatic treatment is far less effec-

tive than in the atopic form. In milder cases the remedies for bronchitis are often helpful. These include: rest in bed; the use of expectorants such as KI .5 grams every 3 hours, and breathing exercises designed to encourage expiration and expectoration.

In more severe cases penicillin is very helpful and used with sulfonamides may be lifesaving and can reduce the period of invalidism by many weeks. These drugs should be given in large doses; up to 30 grams of sulphonamide over 5 to 7 days and full doses of penicillin for 1 to 2 weeks. The latter may be given as procaine penicillin 300,000 U daily or it may be administered as an aerosol by means of an atomizer. Sensitivity to penicillin or sulfonamides which may themselves cause asthma has been recognized and for this reason they should be used with caution. Vaccines are still used but are of little value. However, they may be helpful when one type of organism is grown in pure culture or constantly predominates in the sputum and seems to be responsible for maintaining the infection.

(B) Non-Specific Treatment

(1) psychological treatment. The best results of psychological treatment are seen in children. The recommended approach to this form of therapy is through the parents. They should be encouraged to allow the child to lead as normal a life as possible and they should be helped to understand the child so they may aid in relieving underlying tensions in the child, which are aggravating asthmatic attacks. Encouragement and a reasonably optimistic outlook are essential in the treatment of all asthmatics and wise advice on how to live with and control the disease should be given to both parents and the child, or patient suffering from asthma. When there is an obvious source of anxiety this must be faced and the patient must be taught to appreciate the connection between it and his attacks. In difficult cases Psychiatric assistance may be valuable.

(2) symptomatic treatment

Control of Attacks. Breathing exercises stressing expiration and movements of the diaphragm and lower thorax are often beneficial in cases of mild recurrent asthma especially with mild bronchial infection. In the type of case with mild recurrent symptoms broncho-dilator drugs are helpful. There are several of these, of which Ephedrine ½ gr. (32 mg.) is probably the most useful. It is often more efficient if combined with Theophylline 2 gr. (130 mg.), Phenobarbitone ½ gr. or Sodium Amytal 1 gr. (65 mg.).

Antihistamine drugs are generally disappointing in the treatment of asthma. Nebulizers in the form of small hand sprays, containing various combinations of antispasmodic drugs, are used widely by asthmatics. If used occasionally there is no objection to them. When they are used frequently however, in severe cases they may be harmful due to absorption of too large amounts of these antispasmodic drugs into the blood circulation.

In more severe cases adrenaline is the chief symptomatic remedy. The patient may be taught to give his own injection: 2-5 minims (0.12-0.3 ml.) of 1:1,000 adrenaline hydrochloride early in the attack, but must be warned of the danger of accidental intravenous injection which may be followed by hemiplegia or death.

Aminophylline has achieved an importance in the treatment of asthmatic attacks, which is second only to adrenaline and it is a genuinely useful preparation. The intravenous injection of .25-.5 grains may cut short severe and long standing attacks when adrenaline in large doses has proved ineffective. By

mouth in doses of 1-3 grains (65-200 mgs.), it is of little value except as an adjuvant with other drugs.

Frequently a change in the patient's environment alone will bring about a marked improvement in respiratory symptoms. This has often been noted in asthmatic patients brought to hospital for treatment. The asthmatic attack is often much relieved soon after admission to hospital. Oxygen by mask or in a tent is helpful in relieving the respiratory distress.

Status Asthmaticus

In early stages aminophylline and adrenaline may produce improvement in the patient; but the patient in this condition soon relapses after a short period of improvement. A low grade infection is often present and it is in these cases that penicillin can produce dramatic improvement.

Treatment with intravenous infusions of aminophylline in a glucose-saline drip may be useful, for dehydration often complicates this severe condition. Ethyl chloride 5%, in glucose-saline with addition of .3-1 ml. of adrenaline hydrochloride has also been used and helps the exhausted patient to sleep. These remedies should be given cautiously and should not be continued if improvement is not early apparent. Adrenaline may be harmful as noted previously and aminophylline can cause circulatory collapse; and with intravenous therapy there is always risk of pulmonary edema. The rectal aministration of ether in olive oil: 3 oz. (85 ml.) of ether in 5 oz. (142 ml.) of olive oil; for an adult may give much needed sleep. Paraldehyde is also useful in this respect. It is most effective given intramuscularly in an adult dose of 2 ml. repeated when necessary after an hour.

Bronchoscopy carried out under local anesthesia with removal by suction of thick mucus, obstructing the bronchi and bronchioles may bring about dramatic improvement in resistant or apparently hopeless cases. Oxygen by mask or in a tent is a valuable adjunct to other forms of therapy in cases of status asthmaticus.

Giving Morphine to these severe cases of asthma is inexcusable because of the high death rate due to respiratory failure and because of the possibility of addiction which is always present when this drug is used in chronic illness.

It has been estimated that 9% of asthmatics are aspirin sensitive and death following its use is not rare. The administration of a single tablet of codeine or of aspirin, phenacetin and caffeine can cause status asthmaticus and death.

The severe intractable case of chronic asthma often beginning in the middle age group, and failing to respond to any form of treatment may be helped with Cortisone or A.C.T.H. The prognosis in regard to expectation of life is bad. Desperate measures are therefore justifiable and in such patients surgery may have a place. Bilateral resection of the pulmonary plexus by interrupting the vagal supply to the lungs is reported to have been successful.

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EDITORIAL

The purpose of this Journal is to communicate ideas; ideas both from the field of science and literature. We would rather that these ideas be of undergraduate minds. We realize however that the Journal is an effective teaching instrument and we encourage material for publication from the teaching staff of the University as well; material which we think covers pertinent ideas not presented in the formal lecture.

Ideally the staff of this Journal should work only to *select* material for publication. It is not our duty to solicit ideas. We hold office that through us the undergraduate may express himself. The undergraduates have desired such an instrument of communication and their desire is our only justification for existence as a Journal staff.

Unfortunately, at the present time, our staff feverishly solicits material so that it may fill 6 yearly publications. This is basically wrong. I believe, that we should publish only that material which has been willingly submitted by those truly desiring to communicate, be it enough for only one yearly publication. Our "*soliciting*" must be at a minimum and our "*selecting*" at a maximum.

We as a Journal staff must make the Student aware that such an instrument of communication exists. But it must not go beyond this since we are the means of communication and not the communicators. If the student mind is barren then so is the Journal and its existence is therefore not justified. It is much too expensive.

C.A.S.

1. *Direct light reflex*

When a light is flashed into the normal eye, the pupil of that eye constricts promptly and evenly. Sensory fibres travel back to the pretectal nucleus. [A few sensory fibres may cross early in the optic chiasma.] After a synapse, secondary fibres pass mainly to the contralateral nucleus of Edinger-Westphal, but also to the ipsilateral nucleus. Efferent fibres join III travelling to the ciliary ganglion. From here, short ciliary nerves proceed to the Constrictor pupillae muscle.

2. *Reflex secretion of saliva in response to acid in the month*

VII is sensory from the receptor organs in the anterior two-thirds of the tongue to the salivary centre in the medulla. Efferent fibres leave with the chorda tympani to synapse in a peripheral cell station. Postganglionics then pass to the regional salivary gland (submaxillary or submandibular).

3. *Coronary reflex*

Dilatation of the coronary vessels accompanies increased cardiac output. Constriction results from decreased output. Vagal fibres form the afferent pathway to the vasomotor centre as well as the efferent pathway to the coronary vessels.

4. *Hering-Breuer reflex*

Alveolar distension leads to cessation of inspiration and initiation of expiration. The afferent fibres reach the respiratory centre by way of (X). The phrenic nerve is efferent to the diaphragm.

5. *Carotid reflex in respiration*

Sensitivity of the carotid body to carbon dioxide excess, oxygen lack, and acid excess leads to an increased rate and depth of respiration. Carbon dioxide lack, oxygen excess, and acid lack decrease the rate and depth. The carotid nerve (branch of IX) is afferent to the respiratory centre. The phrenic nerve is efferent to the diaphragm.

6. *Axone reflex*

Not a true reflex. A nerve fibre forms the afferent limb, and a branch of the same fibre comprises the efferent limb, with no nerve cell involved. One example: stimulation of the skin or conjunctiva effects superficial vasodilatation.

7. *Lovén reflex*

Dilatation of the arterioles of one organ is compensated by generalized vasoconstriction. Sensory fibres form the afferent pathway to the vasomotor centre, from which appropriate sympathetic and parasympathetic fibres are efferent to the vessels.

8. *Aortic reflex in circulation*

Increased blood pressure in the aortic arch is compensated by decreased heart rate and peripheral vasodilatation. Similarly, there is compensation for lower blood pressure through increased heart rate and peripheral vasoconstriction. The afferent fibres travel to the cardiac and vasomotor centres with X. Sympathetic and parasympathetic fibres are efferent to the heart and blood vessels.

9. *Bainbridge reflex*

Increased pressure in the right auricle due to increased venous return results in a faster heart rate. Vagal fibres are afferent to the cardiac centre, from which vagal and sympathetic fibres are efferent to the heart.

10. *Vagopressor reflex*

Increased pressure in the right auricle due to increased venous return excites compensatory peripheral vasodilatation, whereas decreased pressure due to decreased venous return elicits peripheral vasoconstriction. There are vagal afferents to the vasomotor centre, and sympathetic or parasympathetic efferents to the peripheral blood vessels.

TREPANATION AS A RATIONAL PROCEDURE IN PRIMITIVE SURGERY

ROBERT E. POPHAM, M.A.*

"l'intelligence de l'homme est née avec l'homme"—de Nadaillac.

As early as the fourth century B.C., Hippocrates commented upon the antiquity of trepanation as a surgical procedure. The operation was quite widely practised in Europe in classical times, during the Middle Ages, and for some time after. However, by the close of the eighteenth century it had been abandoned and was not reintroduced until the third quarter of the nineteenth. At this time it was regarded by European surgeons as a difficult and dangerous undertaking. Therefore, it is not hard to understand the skepticism with which many scientists greeted the evidence, presented by the French anthropologist Prunières in 1873, that trepanation had been practised among Neolithic peoples more than 5000 years ago. Trepanned skulls dating from the Neolithic or New Stone Age had been found before, one in France as early as 1685, but the perforations had been explained as accidental lesions of traumatic origin (17). Shortly after Prunières announced his discovery, the distinguished French anatomist Paul Broca (4), and later other scholars, confirmed his findings. It was demonstrated beyond doubt that Neolithic peoples, who possessed only crude stone tools for the task, had been quite accustomed to perform trepanations, and apparently with an astonishing degree of success.

During the same period when scholars were establishing the existence of this practice among prehistoric European peoples, reports of a different but not less remarkable type were accumulating through the efforts of explorers, missionaries, and scientists in the far-flung corners of the earth. These men published descriptions of trepanations which they had personally witnessed among native peoples technologically no better equipped than the Neolithic Europeans had been. In 1874 the Rev. Samuel Ella's description of trepanning in the Loyalty Islands appeared in the Medical Times and Gazette; others followed, especially from the South Seas. But in 1904 Bandelier wrote that trepanations were still performed by natives in Bolivia and the highlands of Peru (19). Later, archaeological evidence indicated that the practice was of very ancient origin in the central Andean region, the home of the mighty Incan civilization in prehistoric times. By the early years of the twentieth century, the quite frequent occurrence of trepanation among both recent primitive and prehistoric peoples was a well established fact.

Very recently trepanation has once again come into the news and both surgical and anthropological interest may receive a fresh impetus as a result of the work of two Peruvian surgeons, Francisco Grana Reyes and Esteban Rocca. According to a recent issue of Time magazine (October 26, 1953) a trepa-

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nation was performed by them during the past year with the stone and metal instruments of prehistoric Incan practitioners. The patient was a 31 year old cabinetmaker who had lost the power of speech as the result of an accidental cranial injury. Modern methods of asepsis and anaesthesia were employed but the instruments consisted of a bronze chisel, a copper hammer, and saws of obsidian (volcanic glass), borrowed from the National Museum of Archaeology. In addition, a tourniquet of the type probably used by Incan surgeons was placed about the patient's head and is said to have provided an almost bloodless operative field. The operation took 14 minutes and, according to the report, was entirely successful, the patient having since returned to work. The two surgeons, who had studied prehistoric trepanned skulls and experimented on autopsy material for many years, are reported to have said that the operation proved the methods of these early Peruvians to be as good as those of the modern surgeon and in some respects possibly better.

It seems extraordinary that an operation, still considered daring by European surgeons in the latter half of the last century and by no means a trivial undertaking today, should be widely encountered among primitive peoples. Therefore, it may be of interest to the readers of this journal to consider something of the distribution of this remarkable practice, the techniques employed, the degree of success achieved, and the reasons for which it was performed in primitive surgery.

Distribution

Trepanned skulls have been recovered from prehistoric sites, probably for the most part of Neolithic age, in many countries of Europe and in North Africa (2)(17). France appears to have been the primary centre of the practice but specimens have also been found in Italy, Switzerland, Austria, Belgium, and Germany, with sporadic and infrequent occurrences in such southern areas as Portugal, Spain and Algiers, and in the north in Denmark and Sweden. Trepanned skulls are reported as far east as Poland and Russia and as far west as Great Britain though the latter has been questioned (9). Possibly the most curious fact about the temporal distribution of trepanned skulls in the Old World is the extreme rarity of cases from the Bronze Age, the period of cultural development which succeeded the Neolithic. This is the more surprising when it is considered that superior instruments would have been available to the surgeon (16).

Trepanned crania of prehistoric vintage have a wide distribution in the Americas as well as in Europe, though none have as great an antiquity. The primary centre was undoubtedly in the Peruvian highlands where the practice began perhaps 2000 years ago in pre-Inca times (2)(3), attained its peak development among the Incas and persisted into the twentieth century in Bolivia and among the Aymara of Lake Titicaca (19). However, trepanned skulls have also been found in Argentina (17), Chile (19), and Mexico (2). In North America they are rare. Isolated occurrences are recorded for Ohio, Michigan, Pennsylvania, New York and southern Ontario (6). Otherwise, they occur in New Mexico (16), California and Washington (6), and in southern British Columbia (7)(8). Kidd mentions a single example from Kodiak Island which he suggests indicates the route by which the

practice was brought to the New World (7). However, the complete absence of reported cases from Siberia or anywhere in eastern Asia is troublesome in this connection.

The practice of trepanation has been directly observed among native peoples in many different areas. These include Bolivia and Peru in South America; Nigeria, Abyssinia and Uganda in Africa; and in the south Pacific, where the operation seems to have been most frequently and widely practised in historic times, we find it in New Britain, the Loyalty Islands, the Solomons and Tahiti, to mention but a few examples (2).

Apart from the obvious conclusion that the practice of trepanation is astonishingly widespread in both time and space, two additional points in connection with its distribution should be stressed. First, as Loughborough (9) has noted, there is no correlation between the occurrence of trepanation and degree of cultural development. Thus, on the one hand, the practice occurs in such simpler cultures as those of the south Pacific islands and also in complex civilizations like that of the Incas. On the other hand, it is not found in technologically primitive cultures like those of the Australian Aborigines nor in advanced cultures such as those of ancient Egypt, India, China or Central America (Aztec and Maya). Second, Wölfel (19) has demonstrated, in his extensive distribution study, that trepanation occurred only where sling shots or certain types of clubs were customary weapons used in combat. This point has a bearing on the purpose of trepanning which is considered in the final section of the paper. The question now arises as to how this operation was performed with primitive instruments.

Techniques

Experiments with cadavres have shown that the human cranium can be trepanned quite easily with the type of flint or obsidian knife so commonly found on prehistoric sites and still in use among some native peoples (17). Primitive techniques included sawing, scraping, cutting and drilling. The first two were probably the most common, the latter was definitely rare. Shapiro (16) has pointed out that the cutting technique would afford the operator least control and more often lead to death as a result of too deep an incision. Scraping, on the other hand, though a more time consuming and laborious procedure, permits the operator to have the stage of the operation constantly in view. Trepanation by drilling has been observed in Africa. The operation consisted in encircling the area to be removed with a series of small holes and then severing the bridges between them. About an hour was required for this purpose (16).

One of the most interesting accounts of trepanning in a primitive culture is that of Horsley (19) who described the practice in New Britain, where it was performed in cases of skull fracture, as follows:

"The man who performs the operation is the wizard . . . of the tribe or district, using a piece of shell or a flake of obsidian for a trephine. An incision is made over the seat of the fracture generally in the shape of a Y or V and then perhaps some loose fragment is picked out with the finger nail, and while assistants hold back the scalp, the fractured bone is scraped, cut and picked away, leaving the brain exposed. . . . Then, all loose pieces having been removed, the scalp is carefully laid down and the wound bandaged with strips of the banana stalk

about four inches wide. These strips are when dry of a spongy nature. . . . Moreover the inner surface is silky to the touch and forms an admirable dressing for tender surfaces. It is astringent in its action and non-absorbent, all discharge escaping below the bandages. . . . In five or six days the bandages are renewed and in two or three weeks a complete recovery is the result" (pp. 7–8). Wölfel (19) records instances of the use of cocoanut shells in the South Seas, ground smooth and suitably shaped, to close the wound. It has been suggested that the Inca employed gold, silver (19), lead (3), and possibly bone (13) plates for this purpose. However, these techniques appear to have been quite rare. Ordinarily the wound was closed with nothing more than a flap of scalp.

The operation was usually performed on the parietal bone and sometimes on the frontal or occipital; in the former case the sagittal area was generally avoided. The trepanning hole in Neolithic skulls is most frequently circular or oval (5). In Peruvian material, rectangular perforations are more common although oval and even polygonal types occur (3)(14). The holes range in size from simple punctiform perforations to dimensions as great as 9 x 6 cms. On the average, the openings are 4 to 5 cms. in length and 3 to 4 cms. in width (5). Multiple trepanations, involving two or three operations on the same individual, are by no means rare. MacCurdy (10) described a prehistoric skull from Peru on which the operation had been conducted 5 times. All 5 perforations showed evidence of regrowth of bone indicating that the patient had recovered after each operation. Wölfel (19) cited another case of 5 trepanations observed in New Ireland; the individual survived the last by some years and was then killed in combat.

Nowhere was the art of trepanation more highly developed or more frequently in evidence, in a prehistoric or recent native culture, than among the Inca of Peru. Indeed, this was true of their surgical achievements in general. Moodie (12) has commented on this as follows: "I believe it to be correct to state that no primitive or ancient race of people anywhere in the world had developed such a field of surgical knowledge as the pre-Columbian Peruvians. Their surgical attempts are truly amazing and include amputations, excisions, trephining, bandaging, bone transplants, cauterizations and other less evident procedures" (p. 278). At the time of its discovery and early destruction by the Spanish in the sixteenth century, the Incan empire comprised a territory of about a million square miles with more than 10 million inhabitants. It was comparable in most respects to the ancient civilizations of Mesopotamia and of the Nile and Indus valleys.

The Inca made use of tourniquets (3) and surgical bandages in connection with trepanation and other procedures. A surgical bandage, found in situ around an ancient skull, has been described by Moodie (11). It was of finely woven white cloth in a roll about an inch thick, and held in place with a strong, twisted cord of camel wool. The cloth gave the appearance of a good absorbent comparing favourably with modern surgical gauze. Copper thumb forceps (3) were employed for the extraction of foreign bodies or bone fragments in cases of skull fracture. The principal instruments used for trepanation comprised chisels and knives of gold, silver, copper and bronze (produced accidentally as a result of

working copper containing tin as a natural impurity), as well as knives and scrapers of obsidian (3)(14).

Two important questions remain in connection with operative techniques, namely, whether any means were employed for the relief of pain and the prevention of infection. Rare instances of anaesthesia have been recorded (5) and we know that primitive peoples frequently had enormous pharmacopoeiae including depressants of the narcotic variety and various drugs with antiseptic properties (1)(3)(17). However, it appears certain that trepanations were generally performed without the benefit of any pain-reducing techniques. This may not seem so surprising when it is realized that many of these peoples were accustomed to undergo operations much more painful than trepanation (various forms of ritual mutilation, for example), without anaesthetic. Wölfel has suggested that antiseptic substances extensively employed by the Inca in embalming may also have been used in connection with trepanning (19). Again, however, it seems highly probable that techniques which would function to prevent infection were rarely employed.

All of these considerations naturally lead us to wonder just how successful this operation actually was among prehistoric and modern native peoples. What was the likelihood that an individual subjected to trepanation at the hands of a primitive surgeon would recover?

Prognosis

From the viewpoint of the 'asepsis-minded' European observer of today, perhaps the most remarkable aspect of the practice of trepanation among primitive peoples is the fact that *recovery* from the operation, rather than death, was the rule.

Guiard (5), after a detailed study of Neolithic cases of trepanation, including radiographic and microscopic examination, concluded that, "If we were able to compare the number of operative successes effected in trepanation five thousand years ago, to that which is obtained at the present time, the result would certainly favour prehistoric surgery; it is true, that the operative indications have changed and that this procedure formerly so common is only undertaken now in very serious cases" (p. 35). Guiard also remarks that infection was rarely in evidence and where present did not appear to have been serious.

Equally detailed studies of Peruvian material from this point of view are lacking, but those which are available generally present a favourable picture as regards survival rate. The smallest proportion of recoveries is reported by McGee (14) who found that regrowth of bone in some degree was indicated in only 54% of his cases. However, this is at least equal to results obtained with the relative skill and aseptic techniques of European surgeons during the latter half of the nineteenth century, for which period Bluhm reported 50% mortality in 1000 cases of trepanning (16). Tello's figure for a Peruvian sample of 400 crania is more favourable; 62.5% showed evidence of recovery (18). So far as can be determined from a consideration of the various Peruvian samples studied by MacCurdy, the proportions of survivals ranged from 67 to 81 per cent. (5)(10)(19). Finally, Moodie's statement is of interest in connection with the question of post-operative infection. His study was concerned with the relation between

fractures and trepanning in 119 crania (12): "Infections were infrequent, and recovery often from severely infected wounds was common. Most of the injuries healed without infection. Healing was often rapid" (p. 306).

Generally speaking, proportions based upon samples such as these are not a particularly reliable indication either of rate of survival or of operative success. First, macroscopic examination alone may fail to detect some cases in which there has been but a small amount of regrowth. Second, it is difficult to be certain that a trepanned skull, in which there is no evidence of regrowth of bone, does not represent a case of posthumous trepanation; post-mortem trepanning, to obtain amulets and for other purposes was not uncommon, though more frequent among Neolithic than prehistoric Peruvian peoples. Third, it is perhaps a truism to state that death of the patient does not necessarily indicate a surgical failure; but in the case of skull collections it is very often impossible to determine whether death was caused by the surgery or by the antecedent condition for which the surgery was indicated. In any event, we have in favour of prehistoric surgery the fact that all of these sources of error lead to an underestimation of the success of the operation.

A more reliable indication of the success achieved by the primitive surgeon in trepanning can be obtained from students who have directly observed the practice. Let me quote again from Horsley's description of trepanning in New Britain (19): "The number of deaths is about 20 per cent., most of them resulting from the first injury and not from any complication after the operation, and I am assured that if a patient once becomes conscious he never fails to make a good recovery" (p. 8). Horsley's statement is quite typical of comparable reports from other areas. The only important exception is that of Samuel Ella who paints a much less encouraging picture of the operation in the Loyalty Islands (19). He says that "In the best of hands about half of those who undergo the operation die from it". Yet a little further he notes that the practice "has been so prevalent that very few of the male adults are without this hole in the cranium" (p. 11). It is difficult to reconcile these two statements. Moreover, highly favourable accounts of the surgical skill of natives in these islands have been presented by other investigators (19).

Thus, the evidence strongly favours the view that trepanations were generally performed with a surprisingly high degree of success in many prehistoric and recent primitive cultures; this despite the relative crudity of primitive instruments and the absence of asceptic procedures. However, we cannot fully appreciate the significance of this operation in primitive surgery until the reasons for which it was performed have been examined.

Rationale

Various theories concerning the origin and reasons for trepanation among primitive and prehistoric peoples have been formulated. Prunières was the first to argue that trepanation arose in response to cranial injuries sustained in accidents or combat (9). His theory was rejected by Broca (4), however, on the grounds that it presupposed a rational* origin for the procedure whereas primi-

*Following Ackerknecht (1), I use the term 'rational' with reference to logical actions based upon empirical premises as opposed to 'magical' which refers to logical actions based upon mystical or supernaturalistic premises.

tive man was held to be inspired entirely by mysticism rather than empirical observation. Broca dismissed fractures as the primary indication and maintained that trepanation had been performed to relieve epileptics of an evil spirit which escaped through the opening. Others have since argued in favour of a magical origin for the operation but hold that incidental observation of its curative value led to its adoption for therapeutic purposes, especially fracture treatment (14). However, regardless of the manner of its origin (and this we shall presumably never know with any degree of certainty), the evidence at present definitely supports the view that trepanation was primarily a rational treatment of skull fracture in primitive and prehistoric surgery.

The correlation, previously mentioned, between the occurrence of trepanning and the customary use of sling shots or certain types of clubs in battle, is at least presumptive evidence that skull fracture was an indication for the procedure. Direct evidence based upon observation and enquiry among primitive peoples strongly confirms this view (2)(5)(19). Moreover, the facts favour the same conclusion as regards prehistoric Peruvian material. Some of the evidence for this includes the fact that: (a) no children's skulls and relatively few female skulls have been trepanned (10)(13)(14); this may be best explained as the result of reduced exposure to the hazards of battle; (b) trepanation has much more often been conducted on the left side of the cranium than on the right; since the majority of persons are right-handed, the risk of injury to the left side of the skull in combat would be greater (10); and (c) that an antecedent fracture has been directly demonstrated in a great many cases of trepanation (10) (12) (18). Thus, it seems clear that Peruvian trepanning was employed primarily in the treatment of cranial injuries such as might have been produced by the spiked stone and copper headed war clubs frequently encountered in the area (3). Doubtless accidental fractures were also sometimes sustained as a result of falling stones, which would be one of the hazards of life in a mountainous region.

In addition to fractures other less common reasons for trepanning occurred. Cases in which the operation was apparently employed for the removal of diseased bone or the relief of compression in brain tumour have been found in Peru (10)(12)(18) and New Mexico (16). Other indications for trepanning have been noted among various south Pacific peoples. These included headache, vertigo, neuralgia, epilepsy and certain forms of insanity. In one case the operation was apparently considered an aid to longevity (2)(5)(19). It is true that in these cases trepanation was generally a magical rather than a rational treatment. However, while from our enlightened twentieth century standpoint we may regard the primitive surgeon as *misguided* in these instances, we can by no means consider his action illogical. If, for example, one accepts the premise that epilepsy is caused by an evil spirit lodged in the head, then it would be entirely logical to trepan. Rivers (15) has thoroughly demonstrated that primitive peoples consistently act with perfect logic in the medical area, though they very often do so on the basis of mystical rather than empirical premises. We might also note in this regard, that European surgeons up to the seventeenth century trepanned in cases of epilepsy in order to release the "evil air" (17). Most stu-

dents of the problem are now agreed that these less evident and sometimes mystical reasons for trepanning are secondary, and probably represent later extensions of the practice from its original and entirely rational function in the treatment of fractures.

I would not like to leave the reader with the impression that this argument has been an attempt to show that primitive medical and surgical practices in general are rational in nature. This is clearly not so. However, when the magical and purely habitual aspects have been eliminated, there remains, as Ackerknecht (1) has brilliantly shown, "a hard core of rational and naturalistic elements" (p. 492). It is my belief that the practice of trepanation primarily belongs to this part of primitive surgery.

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CASE REPORT

JOHN C. STEARS, B.A., 5T4

Mr. W. R., age 20, upon referral from a rural Ontario hospital, was admitted to the medical service of a city hospital on October 4, 1953 and transferred to the surgical service on November 4, 1953.

Chief Complaint

Pain in the right lateral aspect of the trunk which began suddenly 10 days before admission and gradually subsided after 1 week.

History of Present Illness

(1) This patient was in his usual state of good health until sometime in November, 1952 when he noted the onset of a head cold characterized by unproductive brassy cough, sneeze and mild coryza. This continued until early December when the cough became productive of small amounts of whitish-yellow mucoid sputum. A more serious respiratory infection rapidly developed and kept the patient away from work on his father's farm for 6 weeks. During this time he complained of general malaise, cough and sputum, perhaps moderate tightness in the chest with mild dyspnoea and a fever which rose to a maximum of 102° F. There was no history of chest pain but on one occasion he coughed up a couple of tablespoons of bright red blood. He apparently responded well to Penicillin and later Aureomycin therapy. The hollow brassy cough persisted until June, 1953, still productive of whitish-yellow mucoid sputum. Otherwise the patient felt perfectly well all spring and summer and carried on with his very hard work.

(2) A chest plate taken at a Mobile X-ray Clinic revealed some abnormality and the patient was advised to come to Toronto for investigation. However, the patient felt well and did not do so.

(3) Ten days before admission, the patient was awakened at 3 a.m. by a severe sharp, knife-like pain in a large area in the right flank and over the right chest laterally, radiating up toward the axilla, toward the loin, and downward through the right lower quadrant toward the pubis. This pain was steady, aggravated by respiration but not by movement. He was able to drive to a doctor who gave an injection of an analgesic. He was admitted to a local hospital and there the diagnosis of acute pyelonephritis was made. His urine was said to be loaded with pus. He ran a fever of about 102° and had intermittent pain for a week. The patient complained of no urgency, dysuria or other urinary symptoms. He received vigorous antibiotic therapy—Penicillin, Streptomycin, Gantrisin.

(4) The patient was admitted to a city hospital on October 4, 1953 for investigation of both renal and respiratory systems.

Functional Enquiry

The patient felt well on admission. No history of weight loss, intolerance to heat or cold, anxiety or nervousness. There were no abnormalities noted in any system.

History of Past Health

Usual childhood illnesses and an appendectomy in 1937.

Family History

Non-contributory.

Personal History

The patient has always lived on his parent's farm and done farm work. He completed Grade VII at school at age 15. He does not smoke, associate with girls or take alcohol. He drinks unpasteurized milk from his own farm but states that the cattle are healthy.

Physical Examination

A tall, well-muscled, rather thin and lanky youth. Moderately dyspnoeic while lying at rest in bed. Lips and nails were slightly cyanotic. No clubbing of fingers or toes. Arms were extremely long.

Head and Neck—No abnormalities. No cervical, axillary or supraclavicular nodes palpable. No jugular venous distension. Trachea midline. Thyroid gland normal size.

Respiratory System—Static and dynamic symmetry. Trachea midline. No palpable thrills or rubs. Vocal fremitus and vocal resonance markedly reduced over entire right lung, except for the area above the 3rd rib anteriorly where these were normal. Percussion revealed flatness of the entire right chest with normal resonance over the right apex anteriorly only. The left chest was normally resonant except for a circular area of dullness about 2 x 4" projecting from the upper half of the left border of the sternum above the cardiac area. The apex of the heart lay in the 6th interspace one inch lateral to the midclavicular line. The lung borders on the left were normal and moved well with respiration. On auscultation amphoric breath sounds were noted over the right apical region anteriorly, and breath sounds were decreased over the lower aspect of the right lung, anteriorly and posteriorly. The left chest was normal to auscultation.

Cardiovascular System — Rate 90, rhythm regular. BP 140/60. No praecordial thrill. A blowing systolic murmur was heard along left border of the sternum.

Abdomen—Thin and flat with no palpable organs. Tenderness in the right lower quadrant on deep pressure. Tenderness in the right costovertebral angle. No rebound tenderness or rigidity. Genitalia normal. Hernial orifices clear.

Back and extremities, skin and neurological examination revealed no abnormal findings. Temperature was 101.8° (oral).

Laboratory Work

Urine—Loaded with RBC's, occasional WBC. SG 1026, reaction alkaline.

Blood—Haemoglobin 76%. WBC 19,000. E.S.R. 84 mm. per hour (Westergren).

Thoracentesis—15 cc's of bloody fluid was obtained from the right chest. Bacteriological smear and culture revealed no organisms, and pathological examination revealed no malignant cells.

Chest Films—P.A. and lateral films of the chest revealed a sharply demarcated density 11 x 13 x 12 cm. in the anterior part of the superior mediastinum, projecting slightly down into the anterior mediastinum, slightly removed from the sternum. It projected from the upper half of the left border of the sternum about 6 cm. and only slightly above the right border. The margin was smooth with evidence of calcification in the mass.

SUMMARY

A 20-year-old white farm youth, admitted for investigation of a mediastinal tumour detected first on routine chest X-ray 6 months before admission. There is a history of a 6 week respiratory infection about 9 months before admission. The presenting symptom was the sudden onset of severe sharp steady pain over the right side of the trunk, flank and chest, with radiation to the axilla and to the right lower quadrant of the abdomen. This pain began 10 days before admission and gradually subsided to end 1 week later. During this period he was treated in another hospital while his temperature averaged 102° and his urine was loaded with pus cells.

DIFFERENTIAL DIAGNOSIS

The nature of the pain as presented is not clearly suggestive of either pleural, renal or ureteral pain. Signs and symptoms on admission here were entirely respiratory, and it was felt that the history of a urinary infection was incidental. The signs in the chest are those of a right pleural sanguinous effusion, and of a grapefruit-sized, sharply demarcated, anterior-superior mediastinal tumour. The findings are probably related and can be accounted for by postulating a rupture of the contents of the tumour into the right pleural space. The absence of a mediastinal shift probably indicates fixation of the mass to the sternum. The differential diagnosis of tumours of the anterior-superior mediastinum must include the following.

(1) *Teratodermoid Tumours*—The sharp, discrete outline, and the suggestion of a calcified capsule are in favour of this diagnosis.

(2) *Tuberculous Adenitis*—Must always be considered in any long-term respiratory disease. The history of ingestion of unpasteurized milk may prove significant.

(3) *Retrosternal Thyroid Tissue*—The thyroid gland is not enlarged, and ectopic thyroid tissue retrosternally is rare. Further he shows no symptoms of hyperthyroidism.

(4) *Cystic Hygroma*—Primarily a childhood tumour of the neck which may extend into the superior mediastinum. In the X-ray, the tumour under discussion can be fairly definitely delineated above, ruling out continuity with such a cervical lesion.

(5) *Thymoma*—A very rare tumour which may be associated with myasthenia gravis, absent here.

(6) *Lymphoma*—These tumours are common in the middle mediastinum but uncommon in the anterior mediastinum. Frequently these show a scalloped margin in the X-ray.

PROGRESS NOTES

In hospital the patient felt quite well. He has had a dry unproductive cough, and on two occasions a small amount of dark blood-stained sputum. There has been no shortness of breath or chest pain. His temperature fell from 100-102° during the first two days to normal over the next ten days. Since, there have been elevations to 101° lasting one or two days on three occasions.

Thoracenteses every second or third day removed from 20 to 250 c.c. of thick chocolate coloured fluid each time. By six weeks later, the fluid had become thin and serosanguinous. Repeated bacteriological and pathological studies have been negative. Cultures for tuberculosis are not yet completed. The fluid contained 98 mgm% cholesterol. Tuberculin tests were negative to both 1/20 and 1

mgm. Sputum and urine also have revealed no significant bacteriology on smear and culture.

Haemoglobin ranged between 72 and 77%. The WBC fell from 19.0 on admission to 10.0 two months later. The ESR rose from 84 mm per hour on admission to 95 mm one month later.

An intravenous pyelogram on October 23, 1953 revealed no abnormalities.

Bronchoscopy on November 6, 1953 showed moderate antero-posterior flattening of the lower left portion of the trachea and of the left main bronchus. The orifices into the secondary bronchi were all normally patent. Amber sanguinous fluid in the right main bronchus was exuding equally from all orifices.

Thoracotomy was performed on November 23, 1953. An 8" incision was made from the border of the sternum outward along the left 4th interspace. The left pleural space was free of adhesions. A large (11 x 13 x 8 cm.), hard, slightly cystic tumour mass was found in the superior mediastinum, adherent to all the surrounding structures including the pericardium. The tumour was shelled out by blunt dissection along with part of the pericardium during which the tumour mass was accidentally broken into and a considerable amount of cheesy, red material discharged into the left pleural space. The right pleural space was not opened. The major vessels and nerves were not damaged. The left pleural space was washed out with saline, and a closed drainage tube was placed inferiorly in the posterior axillary line. The wound healed well and the drainage tube was removed 3 days post-operatively.

The pathological report described a 440 Gm., encapsulated, fluctuant, malignant teratoma with a wall 1-3 mm. thick. A multiplicity of tissues was represented in the teratoma, some of which were so poorly differentiated that their exact origin was in doubt. Among the more highly differentiated structures were squamous epithelium with skin adnexae (teeth, hair, glands), well differentiated mucosa, smooth muscle, and numbers of distended vascular channels. Epithelium resembling intestinal mucosa was present in an irregular fashion, the individual cells of which were sufficiently pleomorphic and hpyerchromatic to warrant their being regarded as malignant. In other areas glandular epithelium grew in a wildly papilliferous fashion. No invasion through the capsule was observed.

A course of high voltage X-ray therapy was begun about one week post-operatively, applied to the anterior mediastinum. The recovery was rapid and without complications. It is considered likely that the primary tumour has been entirely removed and that any malignant cells spread by rupture of the tumour will be controlled by radiotherapy.

Final Diagnosis

Malignant teratoma.

ABSTRACTS

Clinical Uses in the Currently Available Antibiotics. Maxwell Finland, M.D. British Medical Journal, Nov. 21, 1953, pp. 1115–1121.

The author states some general views and interpretations of the available antibiotics and their application in special situations.

Penicillin still remains the most effective and the least toxic agent available for the treatment of infections due to organisms moderately or highly sensitive to it in vitro. Despite the current fashion of prescribing dosages which seem inordinately high in relation to the sensitivity of susceptible organisms, there is no decreased in vivo activity among recently isolated strains of gonococcus, pneumococcus and Group A streptococcus. The efficacy of purified crystalline Penicillin G in treatment of syphilis remains unchanged. However. penicillin seems to be less effective in the treatment of sub-acute bacterial endocarditis due to the widespread use of the agent.

Oral penicillin is disappointing in the treatment of severe infections due to organisms which are only of low or moderate sensitivity to that antibiotic. Even in the treatment of penicillin sensitive organisms, e.g. gonococcus—oral therapy has not proved as satisfactory as the intramuscular method. When given in large doses by mouth GI disturbances similar to those encountered with similar doses of erythromycin, carbomycin are seen.

The author concludes from the experimental work of Eagle and Weinstein (the observation of the rapid excretion of penicillin from the kidney) that intermittent injections of aqueous sodium or potassium salts is preferable to the repository preparation in the treatment of deep and walled-off foci of infection. Likewise, the use of inhibitors of the renal excretion of penicillin such as probenecid (benemid) will raise the peak levels and sustain high concentrations between intermittent intramuscular injections.

Streptomycin. The agent remains the mainstay in the treatment of TB. Two features have renewed interest in this agent and an increase in its systemic use in non-tuberculous infections.

1. The use of smaller doses (1 or 2 gm a day) and shorter courses to minimize toxic effects on the eighth nerve.
2. Its use in combination with other agents, particularly with large doses of penicillin resulting in increased effectiveness against relatively resistant Gram-positive organisms coupled with reduction of the rate and degree of production of streptomycin resistant variants.

At present it seems that streptomycin should be used in preference to dihydro streptomycin—or perhaps a combined use of the two forms, if the present indications of much lower toxicity in this combination, can be more firmly established.

The Tetracyclines. Its use is accompanied by significantly lower incidence of GI symptoms than the use of aureomycin in comparable doses and in similar patients.

Intravenous aureomycin is the most effective single agent in the treatment of acute diffuse peritonitis.

Tetracyclines are highly effective against all rickettsia and particularly the psittacosis – lymphogranuloma – trachoma group, however there is no clear cut proof that they are efficacious in uncomplicated viral infections.

There is clear-cut evidence of the decreasing efficacy of aureomycin and terramycin in the treatment of staphylococcal infections.

Chloramphenicol. It appears to be appreciably less effective than the tetracyclines against infections with Gram-positive organisms and probably against the lymphogranuloma–trachoma group. It is most effective against the salmonella, proteus infections, highly effective in H.

influenzae meningitis and recently shown to be highly useful in the treatment of serious infections due to staphylococci that are resistant to penicillin and to the tetracyclines. Due to the potential bone marrow depressing effects of this drug it should not be used for minor indications and only after blood studies have ruled out possible antecedent blood dyscrasias.

Erythromycin has been useful in the treatment of staphylococcal infections, particularly those resistant to aureomycin, terramycin.

Carbomycin, appreciably less active than Erythromycin may be effective in the treatment of amoebiasis and granuloma inguinale.

Bacitracin, *Polymyxin*, *Neomycin*, all exhibited inherent toxicity which has limited their use in systemic disease. Each however, has been successfully used intramuscularly when others have failed.

Systemic *Bacitracin* has been successfully used in the treatment of bacterial endocarditis, brain abscesses and meningitis due to Gram-positive organisms resistant to other antibiotics. Being devoid of local irritation, it may be used topically, intrathecally, intraventricularly and into brain abscesses. Its nephrotoxicity may be minimized by keeping the daily dose less than 100,000 units and keeping urine neutral or alkaline.

Polymyxin B and E are used locally and systemically against strains of Pseudomonas and Gram-negative bacilli which are resistant to other forms of treatment.

Neomycin is probably the most toxic of these agents, producing renal and auditory damage so frequently that only the most dire circumstances warrant its use.

All three agents are poorly absorbed by GI tract and hence are used to reduce bacterial flora.

Omnibiotics. The author states that although the discriminate use of antibiotics on the basis of proper indication and proved efficacy may be more difficult to practise, it may well prove to be less disappointing and more rewarding.

IAN VAN PRAAGH

Ovarian Stromal Changes in Endometrial Cancer. E. R. Novak and D. I. Mohler; American Journal of Obstetrics and Gynaecology: (May) *65*, 1099, 1953.

The suggestion that prolonged unopposed estrogen stimulation may be a major etiological factor in the production of adenocarcinoma of the utrine body is not a new one. There is much clinical evidence in favour of the relationship. Attention is directed to the ovary as the normal source of estrogen in the menstruating woman. Studies made on post-menopausal ovaries reveal a significant incidence of ovarian stromal hyperplasia (as well as thecoma and "diffuse thecomatosis") in cases of corporeal adenocarcinoma. The resulting ovarian cells in these cases, thecal cells, are the subject of much controversy regarding their function. Some investigators consider their endocrine secretion to be estrogenic in character; others suggest that it is more likely androgenic. Another group of ovarian cells whose function is poorly understood are the hilar or Leydig cells. The presence of these cells in the ovary in cases of corporeal adenocarcinoma has been reported by some observers and the absence of any in control cases.

With these observations in mind, the authors have examined the ovarian histology in 63 cases of corporeal adenocarcinoma in which each of the patients had passed the menopause by at least one year. As controls, the ovaries of an equal number of autopsy cases were examined. Care was taken to exclude from this group all those who had suffered from conditions of endocrine dysfunction, chronic debilitating disease and abdominal carcinomatosis. Otherwise they were all picked at random from post-menopausal women of the same age group as the cancer patients.

In interpreting the results, the authors place more emphasis on the qualitative changes in the ovarian stromal cells rather than on the quantitative aspect. Since the histological differences between them are minute and of little importance, no

attempt was made to differentiate between hyperplastic stroma, thecomata and "diffuse thecomatosis".

54% (34) of the cancer group showed marked ovarian stromal hyperplasia while only 21% (15) of the control group showed such hyperactivity. The remainder in both groups showed little or no hyperplasia. These results support the work of previous investigators. 7 cases of adenocarcinoma and 6 cases in the control group revealed hilus cells in the ovaries.

Recognition has been given to the increasing amount of evidence in support of estrogen as the inciting factor in corporeal adenocarcinoma. Histologically, the theca cells observed in these cases provide a very logical source for secretion of this hormone.

The authors suggest that ovarian stromal hyperplasia may form part of a generalized endocrine or metabolic imbalance as evidenced by the greater incidence of diabetes, obesity and hypertension in those patients with marked degrees of hyperplasia. The high frequency of obesity and menstrual disorders, reported elsewhere, appear to support this hypothesis. Finally, the pituitary is mentioned as being a possible controlling factor in the stromal hyperplasia and other manifestations of such an imbalance.

J. W. Goodwin

Training of General Practitioners in Psychotherapy. M. Balint, M.D., Ph.D., M.Sc. . . . B.M.J.

Present situation regarding psychotherapy in general practice.

25% or more of general practice work is psychotherapy and ordinary medical training has not prepared the practitioner for what he will have to do. At present, many doctors mechanically prescribe phenobarbitone if the patient is not depressed, and "tonic" if he is. Then he is sent to various consultants, where he is "reassured" that nothing is organically wrong. Soon he gets to see a psychiatrist, who is often too busy to see that patient at all. In this event, he is referred back to the general practitioner, often without any advice except "sedatives" or "tonic". The practitioner then gives either a placebo or "a reassuring talk"; tells him to take a holiday, get married, change his abode or job, or other such advice. These are empirical methods acquired from everyday life and as a result are very limited in their scope.

Experiences in teaching psychotherapy to general practitioners

The results of most courses have been disappointing. The general practitioners, although they have been good trainees and have had much valuable experience, do not do well. Much of the teaching has been lectures and clinical demonstrations, whereas psychotherapy is not "learning new facts", but rather acquiring a new skill.

These must be purely "patient-doctor" relationships and no third person should be present, so that training must be based on reports of the interview with the patient. One problem occurs in getting the doctor to realize and admit his own mistakes and shortcomings, so that he can discuss his own problems frankly. Only such training is found in the psychoanalysis course which consumes two years and several hundred hours.

Training in psychotherapeutic skill

The course has been expanded from "weekly conferences and case discussions" to include discussion, tutorial on psychodynamics (mainly psychoanalytic), and finally to a two year course. (This is in the author's clinic). During training, the general practitioner must remain in his practice, and in control of the patient, with the psychiatrist playing the role of an expert assistant. This means that the general practitioner is still the responsible person and must see the patient through his illness. On any case which is really a problem, the general practitioner has the patient seen by the psychologist and the psychiatrist, but only on the condition that the general practitioner would continue to treat the patient.

The psychiatrists learned from this, that some of their reports were merely "nice phrases" that paraphrased information already known to the general practitioner. They also learned that the "teaching-being taught" atmosphere was to be avoided, for there the psychiatrist appears to perform sleight of hand and does not permit the general practitioner to gain the skill and confidence at psychotherapy that he needs. This also tends to make the general practitioner try to have his cases follow the predictions of the psychiatrist.

The present training scheme in use at the author's clinic comprises: weekly conferences with 6–8 doctors per group, individual or private discussion with general practitioner who needs it. (1 hour per week. The doctors were asked to take part in the group discussions as frankly as they wished.

One objective is to teach the doctor how to listen—not in the "history-taking sense", where objective events and easily explained occurrences arise, but rather in the highly subjective and personal events that are often hardly conscious, or wholly beyond conscious control.

The doctor must be aware of the "automatic patterns", originating mainly in childhood and influenced by emotional experiences in later life, and how these patterns influence the patients in their attitude toward their own illnesses and color their relations to other human beings. The doctor's own response, too, is of great importance and thus he must be aware of his own automatic behaviour and responses. What is needed is an emotionally free atmosphere in which the realization of the differences between beliefs, intentions and actual behaviour can occur. In this way, the techniques and mistakes of the general practitioner are merely expressions of his personality. The author states that "it is a fact that acquiring psychotherapeutic skill is tantamount to discovering some hard and not very pleasant facts about one's own limitations." Though the method is still not easy, or refined, it is workable, even though it may involve a change in the doctor's personality. With this method, there is also the danger that group training may degenerate into group therapy.

Two cases are presented as illustrations of the effectiveness of psychotherapy as managed by general practitioners who were taking the training at the author's clinic.

F. P. Ceresney

Treatment of Bacterial Endocarditis—A Resume: Maxwell Finland: Circulation, 2,292–299 (February, 1954).

(1) Penicillin is the antibiotic of choice in the treatment of most cases of bacterial endocarditis. After a consideration of the mode of absorption action and excretion of penicillin and lesion of bacterial endocarditis, author lays down relatively dogmatic mode of therapy:

(a) Intermittent, intramuscular injections of aqueous sodium or potassium (depending on cardiac and renal state of patient) penicillin G at intervals of two to four hours.

(b) Usual dose of 100,000 to 500,000 units per dose in most cases with higher levels as indicated by in vitro sensitivity, evidence of uncontrolled bacteremia or when there is other evidence of persistance of active infection.

(c) When dose required results in pain on injection, oral probenecid (Benemid) in dose of 0.5 Gm. every six hours given continuously may permit reduction of dose by one-half. In use of latter, simultaneous use of salicylates contraindicated.

(2) Streptomycin is a highly useful agent in treatment of bacterial endocarditis when used alone, for treatment of infections with organisms highly sensitive to that antibiotic, but particularly in combination with penicillin for the treatment of infections due to organisms that are only slightly or moderately sensitive to penicillin alone. Dihydrostreptomycin is no better than streptomycin apart from its usefulness as an alternative on development of toxicity to the latter.

(3) Bacitracin in 1% procaine in intramuscular doses of 100,000 U per day has received favourable reports as to usefulness as an adjunct to penicillin in bacterial endocarditis due to G+ve organisms and as to low nephrotoxicity in such doses.

(4) Use of Aureomycin, Terramycin and Chloromycetin to be used only when penicillin alone or in combination with streptomycin or Bacitracin has failed clinically or in vitro or when latter agents are contra-indicated in the face of marked hypersensitivity. Not recommended for initial therapy when diagnosis of infecting organisms in doubt.

(5) Erythromycin and carbomycin have thus far proved ineffective.

(6) In cases in which clinical diagnosis made but negative blood cultures have been obtained, a delay of 48 hours, during which intensive clincal and bacteriologic study is made, is advocated, followed by treatment with massive doses of penicillin in combination with streptomycin. A delay of less than 48 hours advocated only when infection particularly severe and of long standing, or evidence of cardiac failure present or evidence of extensive embolic phenomena. Change to another antibiotic made if response is poor or positive culture with alternative sensitivity obtained.

(7) Use of ACTH or cortisone involves risk of developing disease in valves previously free, aggravating disease in valves already involved and possibly also of reducing efficacy of anti-bacterial therapy.

D. W. Wilson

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Syrup Tolu	q.s.	q.s.

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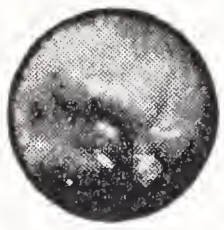

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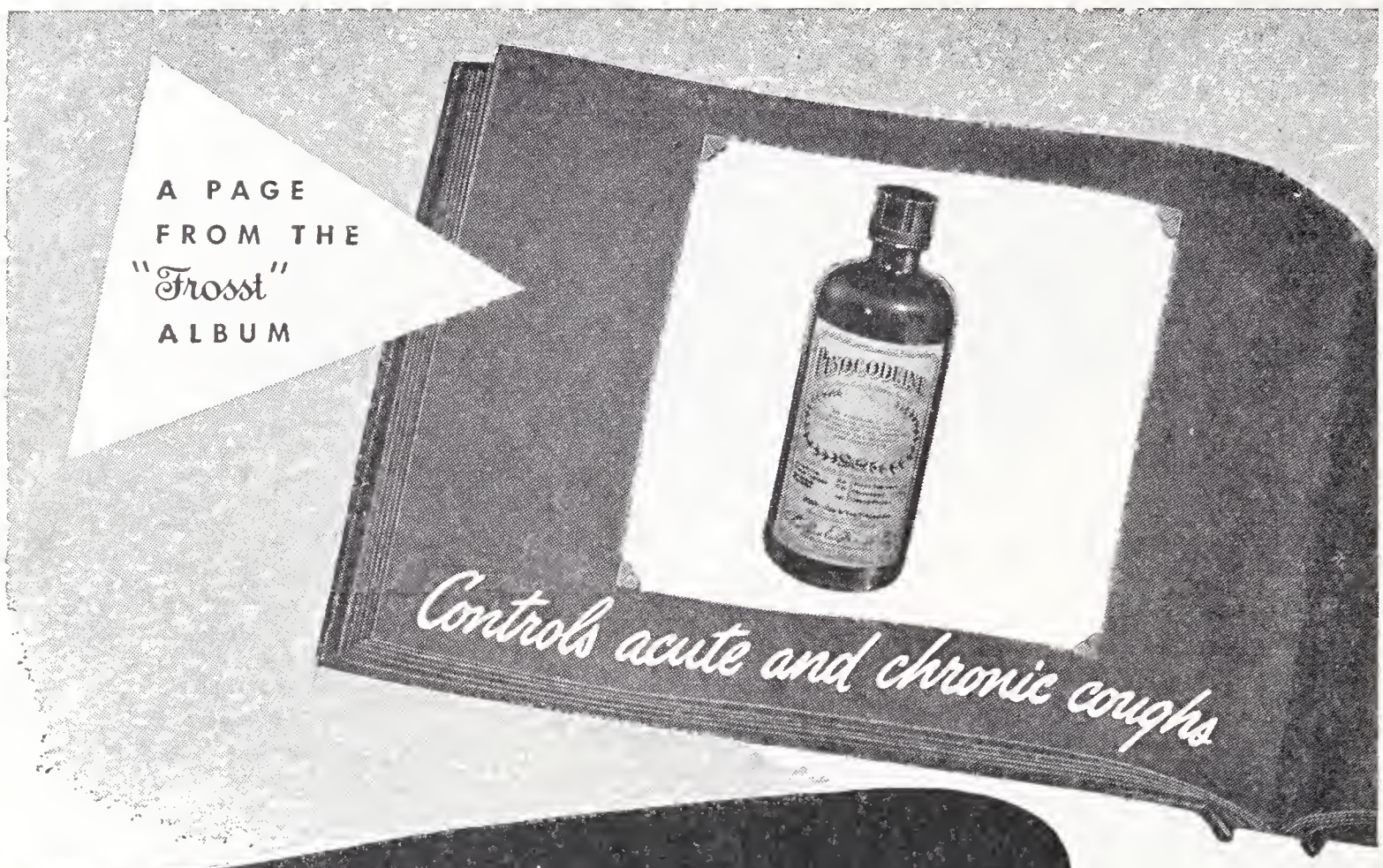

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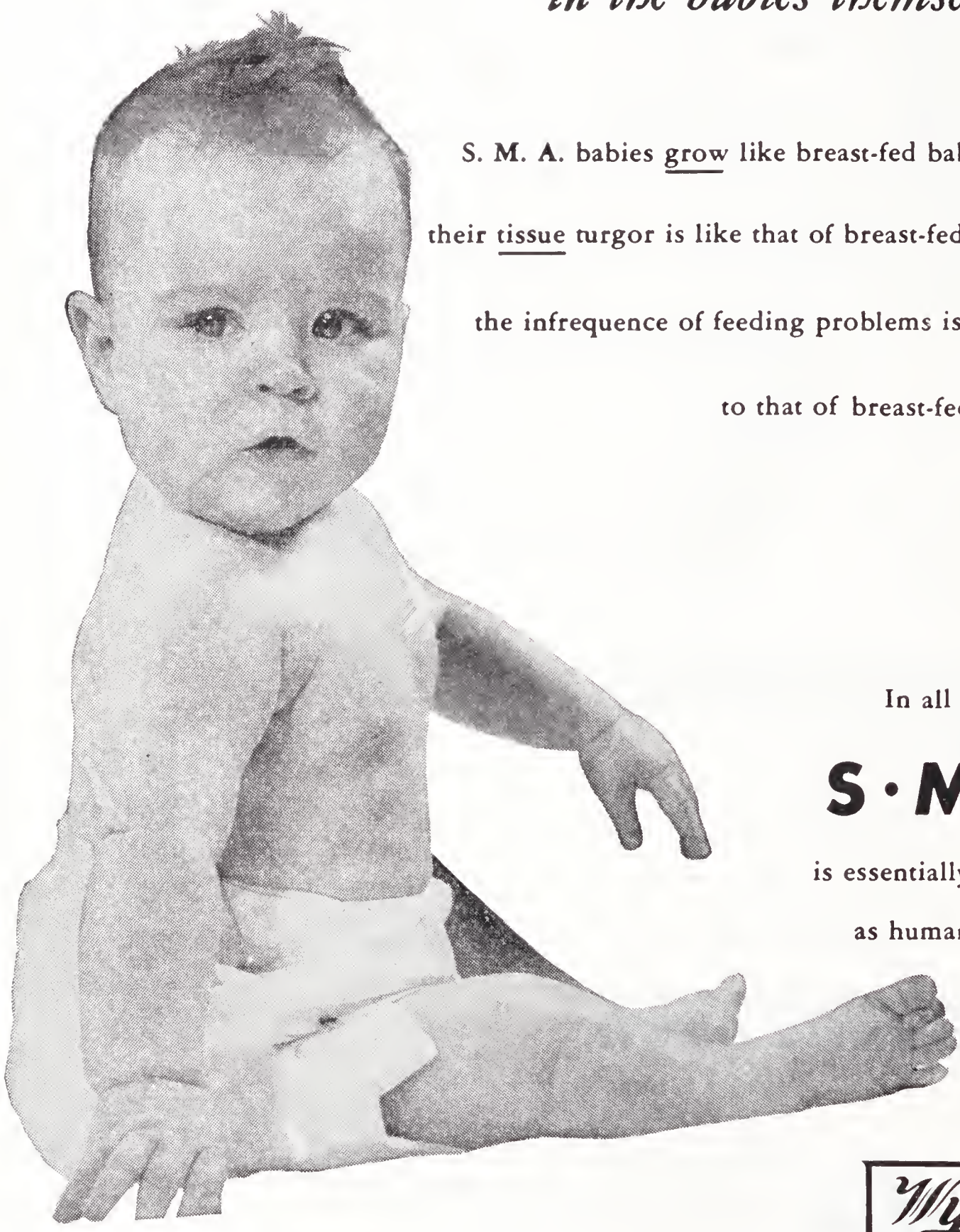

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